THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(*Continued from page* 381.)

CCCCII.—OWEGO.

Owego, New York, in lat. 42° 15′ N., long. 76° 20′ W., is on the Susquehanna River in a hilly region.

Water-works were built in 1879 by S. L. Wiley for a private company, taking the supply by gravity from Barnes Creek, a mountain stream of about 3 square miles water-shed. An earth dam 60 ft. high, with slopes of 2½ to 1 on the inside and 2 to 1 on the outside, forms a reservoir on the stream, 2½ miles distant from and 235 ft. above the town. The water is filtered through sand and gravel and conveyed through 12-in. cast-iron pipe to a small reservoir in excavation, with paved slopes, on a hill near the town. When the supply from this source is deficient in extreme drought, it is supplemented by pumping from a well in the upper part of the town by a compound Deane steam pump of 500,000 gallons daily capacity.

Distribution is by 10½ miles of pipe, of from 12 to 2 in. diameter. Pipes of 4 in. and greater diameter are of cast iron. Those under 4 in. are of wrought iron, coated with asphalte. There are 51 fire hydrants, 25 gates and 248 taps. The town pays $50 per year for each hydrant. Service-pipes are of wrought iron, coated with asphalte, and of lead.

The population in 1880 was 6,037 and the daily consumption is 200,000 gallons.

The capital stock of the company is $100,000. No further financial statistics are given.

S. L. Wiley is the general manager and H. W. Moore the Superintendent.

CCCCIII.—KINGSTON, CAN.

Kingston, Ontario, in Canada, in lat. 44° 8′ N., long. 76° 41′ W., on Lake Ontario, is on ground sloping up from the lake to an elevation of 80 ft.

It was founded in 1784 on the site of the old French fort Frontenac, which was built about 1675.

Water-works were built by a private company in 1849, after plans of R. L. Innes, taking the supply from Lake Ontario. A wooden crib, divided into compartments filled with coarse stone, gravel and sand, is submerged in the lake. From the bottom of this filter, which is said to be able to pass 3,000,000 gallons per day, the cast-iron suction pipe of the pumps is led. The water is lifted 80 ft. by a steam engine (beam) with double-acting vertical plunger pumps of 8-in. bore and 54-in. stroke, into a reservoir holding 600,000 gallons. An 8-in. stand-pipe, used to give fire pressure in the mains, rises 15 ft. above the reservoir. Distribution is by 10 miles of cast-iron pipes of from 8 to 3-in. diameter, with 42 fire hydrants, 45 gates and 816 taps. There are 20 meters. The city pays $275 per year for fire hydrant service. Service pipes are of lead.

The population in 1880 was 15,000. The daily consumption is 750,000 gallons.

The capital stock of the company is $120,000. The works have cost $160,000. There is no debt. The expenses in 1881 were $8,325 and the receipts $19,000.

R. L. Innes was Superintendent to 1854 and James Wilson has held the position since that year.

CCCCIV.—RENOVO.

Renovo, Pennsylvania, in lat. 41°15′ N., long. 77° 45′ W., is on the West Branch of the Susquehanna River, in a mountainous region.

Settled in 1863, it was incorporated as a city in 1867.

Water-works were built in 1872 by the city after plans of E. H. Walsh, taking the supply from a mountain stream, a dam across which forms a reservoir holding 20,000 gallons, 150 ft. above the city and three-quarters of a mile from it. A cast iron main conveys the water to the tank. Distribution is by 15 miles of wrought iron and cement pipe of from 10 in. to 13 in. in diameter, with 29 fire hydrants, 29 gates and 265 taps. Service pipes are of lead and of wrought iron.

The population in 1880 was 3,014. The daily consumption is not known.

The works have cost $65,000. The bonded debt is $45,000. The expenses are not given. The receipts in 1881 were $2,200.

The works are managed by the City Council. James H. Ferguson is the Superintendent.

CCCCV.—FREDERICKSBURG.

Fredericksburg, Virginia, in lat. 38° 20′ N., long. 77° 25′ W., on the Rappahannock River, is on a plain slightly elevated above the river and surrounded by hills.

Settled in 1727, it was incorporated as a village in 1727, as a borough in 1781, and as a city in 1870. Water-works were built by a private company in 1832, after plans of Alexander Henderson, taking the supply from Poplar Springs, half a mile from the town. It is distributed through 4 miles of cast-iron pipe, with 225 taps. There are no fire hydrants. Service pipes are of lead.

The population in 1880 was 5,000. The daily consumption is not known. The water is only used for culinary purposes. The citizens generally use water from wells provided by the city government. The capital stock of the company is $17,000. The works have cost $25,000. No further financial statistics are given.

J. W. Sever has been the Superintendent for 25 years.

CCCCVI.—LEWISTON, ME.

Lewiston, Maine, in lat. 44° N., long. 70° W., on the Androscoggin River, is on undulating ground, rising from the river to hills 350 ft. high. There is a fall of 70 ft. in the river opposite the city, which is utilized for water-power for manufacturing purposes. The source of the Androscoggin is a chain of mountain lakes with 80 square miles water-shed, about 100 miles above Lewiston. The town was incorporated in 1795 and chartered as a city in 1863.

Water-works were built by the city in 1878 after plans and under superintendence of M. M. Tidd, C. E., taking the supply from the river above the falls and pumping it by two Worthington duplex pumps, of 3,000,000 gallons daily capacity each, driven by two Risden turbines. A brick conduit conveys the water from the pond to the pump-well. In 1880 a filter of 400 square ft. area, with 32 in. of sand and sea gravel, was constructed in the conduit. The water passes up through the gravel and falls over a weir to the well.

The pumps lift the water 250 ft. through 10,450 ft. of 24-in. pipe to a reservoir 15 ft. deep, built in side hill excavation and embankment, the inner slopes paved with cobble-stones, and holding 15,000,000 gallons, at 220 ft. above the general level of the city. The pressure in the mains is from 70 to 120 pounds, according to location.

Distribution is by 23 miles of cast-iron pipe of from 24 to 4-in. diameter, with 148 fire hydrants, 175 gates and 1,800 taps. There are 25 meters in use. The city contributes $40 per year for each fire hydrant. Tarred wrought-iron service pipes are generally used, and some of galvanized iron.

The population in 1880 was 19,083. The daily consumption in 1881 was 1,016,260 gallons, with 1,518 taps.

The works have cost $500,000, including $200,000 paid for water-power and privileges. The receipts have been $61,332.38. The bonded debt is $474,000 at 5 per cent.

The expenses in 1881 for maintenance and repairs were $14,711.32, and the receipts $25,837.88.

The works are managed by a board of seven commissioners, one being elected by the City Council each year. James Dempsey is President of the board; John Read, Clerk and Registrar, and John F. Nash, Superintendent.

F. F. Forbes, Superintendent of the Brookline (Massachusetts) Water-works, and Edward S. Philbrick, C. E., having noted some inaccuracies in the description of those works on p. 251, ENGINEERING NEWS, of July 22, 1882, have furnished more complete data and a full set of the reports, which enable the following description to be prepared. It is to be substituted for the one previously printed:

CCCLX.—BROOKLINE.

Brookline, Massachusetts, in lat. 42° 40′ N., long. 71° 10′ W., on the Charles River and a small, tidal estuary called Muddy River, is bounded on three sides by the city of Boston. It comprises about 200 acres of salt marsh, 500 acres of a plain of river gravel rising to about 100 ft. above tide, and hills of glacial drift rising from 300 to 500 ft. above tide. Settled in 1634, it was incorporated in 1705.

Water-works were built by the town in 1875, after the plans and under the superintendence of Edward S. Philbrick, C. E., taking the supply from the ground water on Cow Island, a ridge of gravel surrounded by marshes, alongside of the Charles River, about 6 miles from the heart of the town.

A collecting gallery was excavated from 100 to 300 ft. from the river, in clean, coarse sand and gravel. Its bottom is 6 ft. below the lowest stage of the river. It is 4 ft. wide, with vertical side walls 2 ft. high, of uncemented rubble stone, and covered by a semi-circular brick arch 8 in. thick. At first, two sections, respectively 491 and 271 ft. long, were built, connected by 389 ft. of 24-in. stone-ware pipe with cemented joints, laid through a peat bog, from which it was not deemed advisable to take water. From the filter gallery, a conduit of 24-in. stone-ware pipe was laid on a timber foundation in saturated gravel and sand 6½ to 10 ft. below the surface of the swamp for 3,074 ft. to the pump well and engine house. This was completed in November, 1874. In July, 1875, it was found that 10 per cent. of the pipes were broken by the weight of the superincumbent gravel. They were removed and replaced by a flume of 3-in. white pine plank, 2 ft. square inside, and with tongued and grooved joints.

In 1878 there were complaints of impurity of the water, and it was found that the wooden conduit had shrunk, admitting swamp water and sand through the joints. The gallery which, when first constructed in September, 1875, had yielded 1,602,000 gallons per day on a 36-hour test, with the water in the pump-well 2.75 ft. above the gallery floor, yielded in July, 1878, 1,160,000 gallons per day with the water 2.30 ft. above gallery floor. The average daily consumption had increased from 200,000 gallons in 1875 to 465,000 gallons in 1878. The pumping station was removed to near the gallery, a 16-in. cast-iron force main substituted for the wooden conduit, and an additional gallery, 160½ ft. long, 6 ft. wide and 6 ft. high in the center, built from the pump-well to the old gallery. Weirs are so arranged that the water can be drawn from the new gallery at 7 ft., and from the old gallery at 6 ft. below low water in the river. This work was done after plans of Shedd & Sawyer, civil engineers. In examining the other old gallery, after the new arrangements had rendered it practicable to draw down the water, it was found that 460 ft. of its length was rendered useless by about 18 ft. of the arch having fallen in, evidently as soon as it was built, as the space had been filled with débris of brick, broken stone-ware pipes, brush, lumber and gravel. This was repaired and the whole length of galleries, 923 ft., made available. In June, 1880, the yield of the galleries was 1,000,000 gallons per day, and the daily consumption 1,200,000 gallons. On the recommendation of Gen. George S. Greene, C. E., a canal was dug along the bank of the river, parallel to and 30 to 50 ft. distant from the gallery for 150 ft. The bottom of the canal is 3 ft. below the river level and it is connected with the river. The admission of water from the river to this canal increased the yield of the galleries about 300,000 gallons daily.

The first pumping engine was a Worthington duplex compound condensing engine, with steam cylinders of 21¼ and 43½ in. and water cylinders of 16 in. diameter, all of 24 in. stroke, pumping through 9,070 ft. of 14-in. cast-iron pipe to a brick well 4 ft. in diameter and 17 ft. deep on Walnut Hill. The bottom of the well is at the same level as the water surface in the reservoir, 160 ft. above low water in the river. The 14-in. force main enters this well or stand-pipe at the bottom, and a 16-in. supply main leaves it also at the bottom and leads 13,000 ft. to the reservoir, with a branch at 6,000 ft. from the stand-pipe, leading directly to the city distribution. While the engines are running, the water is pumped directly into the mains, only the surplus reaching the reservoir.

Another Worthington engine of 1,000,000 gallons daily capacity was erected at the new pumping station in 1879, and the first engine then moved to the same place.

The reservoir is in a natural basin on Fisher's Hill. It is in excavation and embankment, with the bottom covered with 12 in. and the slopes with 18 in. of clay puddle. The bottom was then covered with 4 in. of gravel concrete, and the slopes with 12 in. of broken stone, on which was laid a dry slope wall of stone 15 in. deep. During construction, springs in the gravel banks gave trouble by softening the puddle. This was obviated by making pockets of broken stone and leading the water through the puddle by gas pipe. On the completion of the work the pipes were plugged.

Distribution is by 28.5 miles of cast-iron pipe, of from 16 to 2 in. diameter, with 164 fire hydrants, 150 gates and 1,013 taps (February, 1882). The town pays $25 per year for each fire hydrant. Service pipes are now exclusively lead. Wrought-iron pipes enameled, cement lined and tarred have been used with unsatisfactory results.

The population in 1880 was 8,100. The number of taps in use at the end of each year and the daily consumption for the year have been as follows:

	Taps.	Daily consumption Gallons.
1876	587	336,455
1877	702	352,042
1878	755	462,267
1879	857	489,009
1880	930	570,738
1881	1,013	477,113

The reduced consumption in 1881 is due to inspection of fittings and cutting off waste.

In 1881 the consumption varied from 407,481 gallons in March to 588,607 gallons in August.

The total cost of construction has been $621,530.83 to Jan. 31, 1882.

The bonded debt is $593,000 at 4½ to 7 per cent. interest.

The expenses of maintenance in 1881 were $7,999.94 and the receipts, $14,199.04. The town contributes in addition, for water used for public buildings, $6,497.50.

The works are managed by three Water Commissioners. F. F. Forbes is the Superintendent.

(TO BE CONTINUED.)

CORRECTIONS AND ADDITIONS.—Carroll E. Gray, Jr., reports that there are no water-works in Alliance, Ohio; Corsicana, Texas; Danville, Ill., and Sherman, Texas. July 15, 1882, p. 239, *Cañon City, Colorado.* The works were planned by J. W. Peabody. There are 8½ miles of pipe and 21 gates,

and 204 taps. The city is in lat. 38° 35′ N., long. 105° 15′ W., was first settled in 1858, a second time in 1866, and incorporated 1870. The water is pumped 180 ft. to the reservoir, 130 ft. above the city. July 29, p. 263, *Park City, Utah*, has 100 taps. August 19, p. 289, *Trenton, N. J.*, was settled 1679 and incorporated a city 1792. The reservoir built in 1856 holds 15,000,000 gallons, at 20 to 85 ft. above the city. The pumping machinery comprises a 10″ horizontal pump erected 1853, driven by water, a 12″ horizontal steam pump erected 1865, a 16″ steam pump with compound beam engine erected 1875. Sept. 16, p. 328, *Agawam, Mass.* The supply is procured from 3 large springs within 300 ft., and is collected in a well 12 ft. diameter and 8 ft. deep.

Oct. 14, p. 356, *Middleton, N. J.*, has 546 taps. Oct. 21, p. 369, *Carthage, Mo.*, has 213 taps. Oct. 28, p. 373, *Camden, N. J.* The first water-works were built in 1850. The water debt is $400,000 at 7 per cent. interest. Nov. 4, p. 381, *Hot Springs, Ark.* The population by census was 3,000 in 1880. C. E. Gray, Jr., says it is 7,000 and in summer 4,000 to 5,000 more. H. N. Morphy is Secretary of the Water Co.

The receipt of statistics, as follows, is acknowledged with thanks: From James H. Ferguson, Superintendent, statistics and water rates of the water-works of Renovo, Pa. From James Wilson, Manager and Superintendent, statistics of the water-works of Kingston, Ont. From Isaac Hirsh, statistics and water rates of the water-works of Fredericksburg, Va. From John Read, Clerk and Registrar, and E. A. Nash, City Clerk, full set of reports and statistics and water rates of the water-works of Lewiston, Me. From W. R. Coats, C. E., Kalamazoo, partial statistics of the water-works of Saginaw City and Muskegan. From Travers Daniel, C. E., partial statistics of the water-works of Little Rock, Ark. From J. P. Walton, City Engineer, statistics of the water-works now building in Lincoln, Neb.

MEASUREMENT OF WATER.

In choosing a site for a mill, or in establishing suitable machinery for the utilization of water power, the measurement of water becomes a matter of considerable importance, and a few remarks bearing on the subject may not seem out of place. The unit that is generally used in all measurements of water is a cubic foot per minute, and though other measurements of quantity in any other period of time might be used, it has been found that the above unit is most convenient. The power given out by the stream under consideration depends upon the fall of water, and in measuring the latter two things are to be considered, namely, the head and the flow. The head is measured by the ordinary operation of leveling, while the flow is determined by a variety of methods, depending to a great extent upon circumstances and upon the available means at hand with which to conduct operations. In large streams, the flow can in general be measured only directly, that is to say, the cross section of the stream is found, the velocity of the current is measured at different points in this cross section, and the sectional area is multiplied by means of these velocities. The cross section is found by measuring first the width of the stream, and then finding the mean average depth, and multiplying the two together. Suppose, for example, that we have a stream the width of which at the section selected is 15 feet. In order to find the average depth, we may divide the width, say into five equal parts, which is easily done by stretching a tape or cord across the stream, and laying off the distances required. By now measuring from the center of each of these five divisions, we ascertain the depth of water from the bottom to the surface at the different points, and by adding them together and dividing the sum by five, we obtain the average depth. Multiplying this by the width of the stream, 15 feet, we obtain the square section of the stream.

The most convenient instrument in use for the measurement of the velocity of the current is a small light revolving fan, on whose axis there is an endless screw, driving a train of wheelwork which carries indexes that record the number of revolutions made in a given time. The whole apparatus is fixed at the end of a long pole, so that it can be immersed to different depths in different parts of the stream. The relation between the number of revolutions of the fan per minute and the corresponding velocity of the current, should be determined experimentally by moving the instrument with different known velocities through a pond of still water and noting the revolutions of the fan in a given time. The fan, in practice, must be provided with a sort of hood which covers its upper portion, allowing the water to act only on the lower part. Sometimes, however, in want of an instrument of this kind, different methods must be resorted to, and among them we may mention the following as a very simple one, and one which has been successfully used in numerous experiments at Lowell. Two points are selected on the stream, and a float consisting of a small, thin piece of wood is placed in the middle of the stream, where the velocity appears to be the greatest, and a few feet above the upper point of observation. By the time it reaches this point it will have acquired the velocity of the stream, and the time occupied by the float in passing from one point to the other is carefully noted by observers stationed at the two points above mentioned. In this case, as the float has been placed in the middle of the stream, the velocity obtained is naturally the greatest velocity of the current, and as the friction of the water with the bank of the stream exerts an appreciable influence upon it, suitable deductions must be made in order to obtain approximately the average velocity of the current. It will be readily seen that the method on this account is not perfectly accurate, but in practice it has been found to yield results sufficiently satisfactory to warrant its adoption in the absence of more suitable means. If we denote the maximum velocity obtained by the above method by V, then, according to an empirical formula given by Prony, the mean velocity is

$$v = V\frac{7.71+V}{10.28+V}$$

When the stream is so small that it is practicable to make across it a temporary weir, such a weir is to be made, care being taken that it shall be perfectly water-tight at every point except at the outlet through which the whole flow of the stream is to pass. The site should naturally be chosen with a view to its tightness and security, and the channel of the stream immediately below the weir should be straight, in order that the rapid current rushing from the outlet may not injure the banks. The outlet, as described by Rankine, should be a notch or depression in the upper edge of a vertical board, for which reason weirs of this class are generally known as "notch-boards." The sides and bottom of the notch should be chamfered to an even edge with a vertical surface opposed to the water in the pond above, and in order to fulfill this condition the notch may be edged all around with thin sheet iron. The object of this is to prevent as far as possible a friction and cohesion between the water and the edge of the notch from interfering with accurate results.

A vertical scale divided into feet and decimals, and having its zero point at the level of the lower edge of the notch, is to be placed in the pond above the notch-board at some point where the water is either sensibly still or has only a slow motion, and the height at which the surface of water stands on that scale is to be noted from time to time. If we designate that height in feet by h, and the breadth of the notch by b, then the flow Q in cubic feet per second is given by the formula

$$Q = \frac{2}{3} c\, b\, h\, \sqrt{2\,g\,h},$$

$2\,g$ being 64.4 and $\sqrt{2\,g\,h}$ the velocity due to the hight h, while c is a fraction called the "co-efficient of contraction," expressing the ratio which the sectional area of the most contracted part of the jet or cascade flowing through the notch bears to the rectangle $b\,h$. In general it is advisable that the breadth of the notch should not be less than one-fourth of that of the weir, and it may have any convenient breadth from that amount up to the entire width of the weir. The values of the co-efficient of contraction mentioned above, as given by Rankine are—for a notch of one-fourth of the width of the weir, 0.595, for a notch of the whole width of the weir, 0.667, and for any intermediate proportions the following formula is very nearly correct:

$$c = 0.57 + \frac{b}{10\,B},$$

B being the breadth of the weir.

Besides the variations in the co-efficient of contraction already stated, which depend upon the proportion between the breadth of the weir and of the notch, there are other variations which have been reduced to no general law, depending upon the proportions of the dimensions of the notch to each other. This inconvenience has been avoided by Professor Thomson, who has adopted a form of notch in which the section of the issuing jet is always of a similar figure, that is to say, a triangle with the apex downward. This form of notch has been found to give very satisfactory results, and the velocity of flow from it is calculated as follows; Let h be the depth in feet of the apex of the notch below the surface of the still water in the pond, and b the breadth of the notch at the level of the surface of still water; then the area of the triangle bound by that level and the edges of the notch is one-half $b\,h$, and the discharge in cubic feet per second is

$$Q = \frac{8\,c}{15} \times \frac{b\,h}{2}\sqrt{2\,g\,h}.$$

The "co-efficient of contraction," as given by Professor Thomson, are as follows: When b is equal to $2\,h$, c is equal to 0.595, and when b is equal to $4\,h$, c is equal to 0.620.

Instead of an open notch in the top of the weir board, an orifice or a row of orifices wholly beneath the level of the water in the pond may be substituted, and in that case, on account of the variations in the co-efficients of contraction which occur when the orifice has various proportions of length to breadth, and also when the ratio of the head of water above the orifice to the breadth of the orifice varies, it is desirable to select such forms and proportions as shall give rise to the smallest variations. For that purpose the orifices should be made either square or circular, and their size should be such that the height of the surface of still water in the pond shall not be less at any time than three times the diameter of the orifice. These conditions being fulfilled, let A be the area of the orifice, h the depth of its center below the upper surface of still water, and then the flow through it in cubic feet per second is

$$Q = c\,A\,\sqrt{2\,g\,h},$$

the value for c being for round orifices, 0.618, and for square orifices, 0.6. The value of $c\sqrt{2g} = 8.025\,c$, for round orifices, will be 4.96, and for square orifices, 4.185. No very serious error will be incurred by using these coefficients even when the height h amounts to double the diameter of the orifice.

The formulæ above given will, we think, present no serious difficulties in their application; and as they are sufficiently accurate for all practical purposes, they are considered of sufficient importance to warrant the notice which we have given them.

PIPE-LAYING IN THE STREETS.

"This business of laying steam pipes through the street," said Deputy Commissioner Hamlin yesterday, "has caused us more trouble than I can well express. People come to us constantly with complaints about the interruption of traffic, the useless delay in repaving, and the defective manner in which the work is performed. We haven't begun to get to the end of our trouble in this matter. Gas companies, electric light companies and steam-heating companies got their franchises passed by the Board of Aldermen, and each one has a right to lay its pipe-lines through the streets, to dig and re-dig, until the streets are fairly honeycombed. Now, in regard to the steam-heating business, which is making such a row at present, there seems to be more trouble than ever before. There are two companies calling themselves the American Heating and Power Company and the New York Steam Company. Both are digging and laying their pipes at the same time, and both have secured franchises which grant them the most extraordinary powers and privileges. First one company comes along and digs and lays its pipes, and then the other, and between the two the streets are kept blocked for weeks together, and it is not unnatural that the people should kick. The Department of Public Works has no means of compelling them to work at the same time, so they go as they please. Each company has deposited bonds with the department in the sum of $50,000, by which they agree to restore the streets to exactly the same condition in which they found them. As a matter of fact, it is impossible to relay a street equally well a second time."

"But," said the reporter, "President Andrews, of the New York Steam Company, said only half an hour ago that that was gammon, and that it was quite possible."

"Well," replied the Commissioner, "I'm glad he thinks so, and we'll try to keep him up to it. We do keep them up to it as far as we can. We make them relay every paving-stone, rebuild every sewer, and restore every water-pipe or main they injure. Their gangs of men work under the eyes of our inspectors and plumbing experts, and we bring them up to the scratch every time. At first they had such confidence in the powers given them by their franchises that they were rather high and mighty, but they have come off that since. We only allow them to keep a certain length of trench open at one time; if one street is obstructed the next must always be open and great precautions are taken against possible disaster in case of fire. Beyond that we cannot go. We can't revoke their permit because they take their time about it.

"A letter in a morning paper of Sept. 26 refers to the 'niggardly manner of the New York Steam-Heating Company, which, after blockading the streets for several weeks in laying their steam-pipes, have relaid the pavement in the most outrageous manner, with a sprinkling of sand thrown over it to hide the many defects of unskilled labor.' I do not know who the writer of this, who signs himself 'Peiron,' may be, but he evidently doesn't know much about paving streets, for the sand he refers to is a necessary part of the construction of the pavement. It is true that Broadway pavements are at present in a very unsightly condition, but the settling is unavoidable, and the streets will be leveled three or four times, repaved again, and the concrete laid beneath before the work is

finished. The steam companies wished to avoid the consequences of the settling and save expense by 'mounding up' the earth at first, but we would not allow this, and required them to level the streets flat and correct the defects afterward. The trenches are dug side by side, and frequently it happens that one trench is scarcely filled in when the excavation of another begins.

"Delays in the completion of the work are frequently unavoidable. For instance, lately at the head of Fulton street the New York Company put out a spur to their main at that point. A storm came and the sand was soaked, so that it was necessary to let it dry somewhat before attempting to pack it. At once there was a howl in the newspapers, and the inspector ordered the hole to be filled and paved. Since then it has settled into a rut deep enough almost to overturn a carriage. There is no use in being too quick in doing these things. Part of Broadway has been repaved no less than five times, and the street will not be in good condition again until next spring. The expenses incurred by the companies are enormous. One hundred thousand dollars per mile would, in all probability, scarce cover the outlay. One block alone in William street, between John and Fulton, will not cost less than $40,000. Gas-mains, water-pipes, and sewers have to be removed and rebuilt, elaborate machinery constructed underground, and property owners consulted about their vaults, besides the great expense of paving and repaving. The whole city is undermined by an intricate system of pipes for water, gas, and electricity, and for one company to get its pipe lines through without disturbing those of another is a matter of infinite difficulty and expense, requiring the highest order of engineering ability. As long as we convey our mo dern improvements underground so long must we submit to having our streets torn up."

"But," said the reporter, "how have these steam companies succeeded in getting hold of such extraordinary powers and privileges?"

"Ah," said the Commissioner, shrugging his shoulders, "there you have me—I cannot tell. These things are beyond understanding sometimes."—*N. Y. Times.*

CORRESPONDENCE.

DIFFICULT EARTHWORK MEASUREMENTS.

MARLBOROUGH, N. Y., Nov. 4, 1882.

EDITOR ENGINEERING NEWS:

The assistant engineers on the N. Y., W. S. & B. Ry. have had no easy task in taking measurements for our monthly estimates, especially beside the Hudson River, where the work is almost entirely in side cutting, and the old process of averaging the cut "out to such a station," for the monthly estimate will not do; where we are at work along its whole length, as at present, we are doing in some places, and it becomes necessary to

take measurements and levels over each section as originally taken, and the difference will give the "end area" at the time taken out for the month. But where we have side cuts from thirty to one hundred and thirty-five feet in height, as in Orange and Ulster counties, it is no easy or pleasant task to get these "end areas" on very deep cuts.

After running in the centers and getting the cuts thereon, I have a large square six feet on each arm, one of which I graduate into feet, tenths and hundredths, then with a fine silk cord, one end of which is looped, graduated into even 10 ft. lengths, with flannel tags thereon, I send one assistant with a rope and the cord to the upper slope, who after arriving opposite the station below, lowers the cord over the face of the cliff to another assistant, who takes the same to the center, passes an iron bar or spare drill through the loop, and we get the distance from the center from *B* to *A* very accurately, by counting the red tags, and measuring the fraction from the one nearest to the slope to the point selected by the assistant above. Then taking the square, and with a plain bob or small level hold one arm perpendicular, and note where the string crosses the other, as at *a* in the cut. Then, of course, the triangle *Bca* is equiangular and similar to the triangle *BCA*, and we have the following proportions:

$$Ba = \sqrt{BC^2 + a\,c^2}$$

Then $Ba : BA :: Ca : CA$ = the distance out from the center to the point selected, and $Ba : BA :: Be : BC$, which being added to *BD* gives the cut at *A*. Then the irregularities from *A* to *B* of the surface of the rock are taken by an assistant, who lowers himself with a rope hitched from above, and with a graduated pole measures the ordinate from the chord.

I find this plan a very great convenience in restoring lost slope stakes, or even marking a grade therefrom. To expedite work when taking an estimate, I have a table calculated of lengths of hypothenuse of a triangle, with a constant base of 6 ft., and varying by hundredths on the other arm.

Yours respectfully, R. SMITH MOWRY,
Assistant Engineer, N. Y., W. S. & B. Ry., Ulster County Division.

BROCK'S BRIDGE TRUSSES.

340 SOUTH TWENTY-FIRST STREET,
PHILADELPHIA, Nov. 7, 1882.

EDITOR ENGINEERING NEWS:

As a further contribution to the articles of Mr. Brock, I desire to call attention to the fact that Mr. Finley's patent of 1808 is described and illustrated by Mr. Finley himself, and a statement made that the first patent of Mr. Templeman in the same year was a mere extension of it in the third volume, new series of the *Portfolio*, a journal published in Philadelphia and New York in 1810. This patent is especially interesting, as it describes the first modern suspension bridge, as pointed out by Mr. Bender in the first volume of the "Transactions of the American Society of Civil Engineers." That is to say, he used an auxiliary truss to stiffen the chains, which was fastened at the ends to prevent its rising. He "upset" the links at the ends, used an ultimate value for his iron of 60,000 lbs., and a factor of safety of ¼ to ⅓. He likewise found his strains and the curve of the chains by experiments with a model.

Even so late as 1828 the importance of the stiffening truss does not seem to have been appreciated in England (see pictures of the bridge at Hammersmith, in Franklin Institute Journal for April, 1828, where no truss is shown, although the text says an "ornamental meshing" would finally fill the space between suspension rods).

Among other patents destroyed, descriptions of those of Geo. W. Long, March 10, 1830, of Rich. T. L. Witty (printed Whitley in ENGINEERING NEWS), Oct. 14, 1835, and George Law, June 12, 1835, can be found in the Franklin Institute Journal, New Series Vols. 5, p. 380, 1830; Vol. 17, pp. 336 and 42, 1836. The first is especially interesting, as being probably the first low-strung bridge. Respectfully yours,

THOMAS M. CLEEMAN.

THE BLUE PROCESS OF COPYING TRACINGS.

As we have had several inquiries recently in regard to the best method of copying tracings by what is known as the "blue pointing process," we will give a brief description of the method employed by us; we do not say it is the best, but it certainly is as simple as any other, and has always given us perfect satisfaction.

The materials required are as follows:

1st. A board a little larger than the tracing to be copied. The drawing-board on which the drawing and tracing are made can always be used.

2d. Two or three thicknesses of flannel or other soft, white cloth, which is to be smoothly tacked to the above board to form a good smooth surface on which to lay the sensitized paper and tracing while printing.

3d. A plate of common double-thick window glass of good quality, slightly larger than the tracing which it is wished to copy. The function of the glass is to keep the tracing and sensitized paper closely and smoothly pressed together while printing.

4th. The chemicals for sensitizing the paper. These consist simply of equal parts, by weight, of citrate of iron and ammonia and red prussiate of potash. These can be obtained at any drug store. The price should not be over 8 or 10 cents per ounce for each.

5th. A stone or yellow glass bottle to keep the solution of the above chemicals in. If there is but little copying to do, an ordinary glass bottle will do, and the solution made fresh whenever it is wanted for immediate use.

6th. A shallow earthen dish in which to place the solution when using it. A common dinner plate is as good as anything for this purpose.

7th. A brush, a soft paste brush about 4 in. wide, is the best thing we know of.

8th. Plenty of cold water in which to wash the copies after they have been exposed to the sunlight. The outlet of an ordinary sink may be closed, by placing a piece of paper over it with a weight on top to keep the paper down, and the sink filled with water, if the sink is large enough to lay the copy in. If it is not, it would be better to make a a water-tight box about 5 or 6 in. deep, and 6 in. wider and longer than the drawing to be copied.

9th. A good quality of white book paper.

Dissolve the chemicals in cold water in the following proportions: 1 ounce of citrate of iron and ammonia, 1 ounce of red prussiate of potash, 8 ounces of water. They may all be put into a bottle together and shaken up. Ten minutes will suffice to dissolve them.

Lay a sheet of the paper to be sensitized on a smooth table or board; pour a little of the solution into the earthen dish or plate, and apply a good even coating of it to the paper with the brush; then tack the paper to a board by two adjacent corners, and set it in a dark place to dry; one hour is sufficient for the drying; then place its sensitized side up on the board on which you have smoothly tacked the white flannel cloth; lay your tracing which you wish to copy on top of it; on top of all lay the glass plate, being careful that paper and tracing are both smooth and in perfect contact with each other, and lay the whole thing out in the sunlight. Between 11 and 2 o'clock in the summer time, on a clear day, from 6 to 10 minutes will be sufficiently long to expose it; at other seasons a longer time will be required. If your location does not admit of direct sunlight the printing may be done in the shade, or even on a cloudy day; but from one to two hours and a half will be required for exposure. A little experience will soon enable any one to judge of the proper time for exposure on different days. After exposure, place your print in the sink or trough of water before mentioned and wash thoroughly, letting it soak from 3 to 5 minutes. Upon immersion in the water, the drawing, hardly visible before, will appear, in clear white lines on a dark blue ground. After washing, tack up against the wall, or other convenient place, by the corners to dry. This finishes the operation, which is very simple throughout.—*The Locomotive.*

[A valuable paper on Blue Process Printing was published in the "Journal of the Association of Engineering Societies," for August, 1883, for sale by the Secretary of the association, H. G. Prout, No. 12 Barclay street, New York.—ED. ENGINEERING NEWS.]

THE COST OF ELECTRIC LIGHTING.—The cost of the experiments in electric lighting which have been carried on for some time past at four stations of the Bergisch-Märkische Railway (Germany) at Hagen has been recently published. The outlay, inclusive of the steam-engines, was £1,005 4s., and the cost of 15 lights, replacing 45 gas-lamps, was in June 2s. 6d., and in January 1s. 9¼d., per light per hour, while the expense formerly for gas was 1s. 5½d. per lamp per hour. At Alberfeld the outlay was, exclusive of the engine, £413 12s. The six electric lights, which took the place of 23 gas-lamps, cost 1s. 10d. in June, and 1s. 1½d. in January per light per hour. At Dusseldorf the outlay was about £750. The cost per lamp per hour is 4½d. At Hochdahl, £169 8s. had been expended, while each light cost from 1¾d. to 1½d. per hour. But it is expected that, with the reduction in the price of carbons, the cost will be lowered to 1¼d. or 1¼d. per light. It should be added that the system employed at Hochdahl is that of Schukert, while at the other three stations Siemens' differential lamps are used.

ENGINEERING NEWS
AND
AMERICAN CONTRACT JOURNAL.

Tribune Building, New York City.

GEO. H. FROST.....EDITOR AND PROPRIETOR.
S. D. V. BURR.....ASSOCIATE EDITOR.

SATURDAY, NOVEMBER 11, 1882.

EDITORIAL ANNOUNCEMENTS.

Terms of Subscription.—To the United States and Canada, $4 per annum, including postage; all parts of Europe, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P. O. order, payable to GEO. H. FROST.

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Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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STOPPING WORK ON THE HUDSON RIVER TUNNEL.—On last Monday all work was stopped on the Hudson River tunnel. All connected with the work were laid off, with the exception of enough to run the air compressors, in order that the completed sections may not be flooded.

What caused this step we could not learn, and as the meager information we did obtain led us to believe that it was purely a private matter and had no connection with the engineering features of the work, our "search after knowledge" was not characterized by much vigor. The work has been progressing very successfully all the summer on both sides of the river, and, notwithstanding the difficulties encountered on this side, the aggregate number of lineal feet of finished tunnel is large. On the New Jersey side the heading of the north tunnel is 1,542 ft. from the shaft, and the south tunnel 570 ft.; on this side the heading is 74 ft. out.

The stoppage may be but for a short time, and it may continue all winter. Considering the financial ability of the Construction Company and the present favorable aspect of the work, renewed exertions will be inaugurated soon.

EVERY once in a while the superintendent of a water-works wants to know what the practice in other works is with reference to some detail of the operation of the works. He finds that his company or his commissioners think that he is extravagant, perhaps, and that the service is costing too much. If he could only have some reliable statistics of other places to lay before them to show that this was not the case, it would be worth a good deal to him. Perhaps it would be worth his situation.

Such a collection of statistics we are now placing in the hands of subscribers to ENGINEERING NEWS. We have printed statistics of 405 water-works, furnished by the officers of the works. There are about 260 more towns from which no response has been received. As soon as the returns can be had from them, the whole book will be issued, with tables in which the principal data will be compared and rendered easily understood. We ask every one of our readers to aid the author in his efforts to get together the desired information. We particularly ask every water-works engineer, contractor and superintendent to send all the facts relating to works he has designed, built or managed, in order that the "History and Statistics of American Water-Works" may be complete and thorough.

THE publication last week of the list of towns having water-works, and from which no returns have been received, has excited much interest and over 60 blanks have already been sent to persons who have asked for them. This is gratifying, and we hope that no effort will be spared by every one who is interested in the construction and management of water-works, to secure full and correct data for Mr. Croes' great work.

We ask every water-works superintendent to devote one hour to putting on paper the few bare facts asked for. For ninety per cent. of the towns unheard from, this time will amply suffice to give very full data. One superintendent wrote to Mr. Croes that he had not time to answer the questions on the blank. We are sure he was mistaken, for there is no superintendent in the United States who ought not to be able to answer all the questions by giving ten minutes a day to it for a week. In the case in question we really believe that the gentleman had spent more time in reading Mr. Croes' letters to him than he would have needed to answer the questions in the first place. We may add that very complete and excellent statistics of those works were procured from another source, and such will be the case everywhere, if the officers of the works do not send the information themselves.

FORESTRY BULLETIN No. 22.

SPECIFIC GRAVITY AND ASH OF THE WOODS OF THE UNITED STATES.

Published by Census Bureau.

This contains the report of the special agent in charge of the physical and chemical work of the forestry department of the census office. The results of his determinations of the specific gravity, percentage of ash and comparative fuel values are given for about five hundred kinds of timber grown in different parts of the country under different conditions of soil and climate. The specimens were made 100 millimeters long and about 35 millimeters square, and were dried at 100 degrees centigrade until they ceased to lose weight, and were simply measured and weighed to find the specific gravity. Two determinations of ash were made by burning small dried blocks in a muffle furnace at a low temperature. The comparative fuel values are calculated from the specific gravity and the percentage of ash, and are based on the hypothesis that the fuel value of the combustible matter in all woods is the same. The table gives also the botanical name, the common name, and the region where grown, of each specimen investigated. Out of the five hundred kinds there are sixteen which have, when perfectly dry, a specific gravity greater than unity. Whatever may be thought of the propriety of entrusting the census bureau with scientific investigations of this kind, there can be no doubt but that such exhaustive reports will be very valuable. We hear it rumored that tables relating to the strength of wood and stone will also be published.

RAILWAY COMMUNICATION BETWEEN NORTH AND CENTRAL AND SOUTH AMERICA.

Hinton Rowan Helper, of St. Louis, is well known as the zealous advocate of the "back-bone" or "three Americas" railroad, which he is desirous of building between Hudson's Bay and Patagonia, and the pamphlet with the above title contains his latest contribution to the subject. It is in the shape of a petition to Congress asking for the appointment of a commissioner to visit South America and make the necessary preliminary negotiations and inquiries. Some years ago he paid five thousand dollars for the best essays on this interesting subject, and published them in a book, copies of which he forwarded to all the Senators and Representatives at Washington, many of whom, he complains, have no recollection of having received it. In his memorial he urges the scheme with many arguments more or less forcible. Was it prudent, he asks, for us to open railroad communication with Boston and New Orleans? Equally prudent, he replies, will it be for us to establish regular railway intercourse with the capitals of Ecuador and Paraguay! "In a general way," he claims, "every fact, argument and suggestion that was ever urged in the interest of any railroad whatever, may be legitimately urged, with at least tenfold force, in the interest of the inter-continental railway here proposed."

PERSONAL.

MR. JOSEPH FRANKLIN has been appointed Superintendent of the New York Central & Hudson River Railroad, in place of Mr. J. M. TOUCEY.

MR. W. D. CLARK, Superintendent of Construction of the new Court-house at Denver, Colo., has resigned his position, the Capitol Board of Building Commissioners of the State of Texas having appointed him Superintendent of Construction in the erection of the new Capitol building at Austin.

MR. J. W. SEWALL, Old Town, Me., is Engineer in charge of the Waring system of sewerage now being introduced into Keene, N. H., by the Drainage Construction Co. W. F. YATES, of Memphis, Tenn., and P. F. BABBIDGE, of Old Town, Me., are first assistant engineers upon the same work.

TWENTY-FIVE years ago HENRY VILLARD, the President of the Northern Pacific, was in Racine and engaged in a newspaper enterprise. To obtain money he gave a note for $300 which was indorsed by SAMUEL RITCHIE. VILLARD was unable to meet his obligation and Mr. RITCHIE was obliged to pay it. A few days ago he wrote to VILLARD and offered to surrender the note for $500. Mr. RITCHIE received a letter from Mr. VILLARD with a check for $1,000. The latter supposed the claim had been paid years ago.

NEW PUBLICATIONS.

Proceedings of the Association of Municipal and Sanitary Engineers and Surveyors. London, 1882.

England is *par excellence* the country of sanitary reform. The Public Health Acts, the reports of numerous eminent Commissioners appointed by the government to inquire into almost every phase of sanitary science, the various societies organized to investigate and discuss co-relative questions, far exceed in number those in any other country.

The above publication contains the proceedings of a society composed of civil engineers and surveyors holding permanent appointments under the municipal corporations in England, numbering nearly 200 members and representing nearly every prominent town. We may therefore expect to find in it a fair expression of opinion regarding the most advanced principles and practices of sanitary engineering. Besides containing the results of actual experience together with deductions, we also find, as is natural, some extravagant notions on the capabilities of engineering and of certain special devices to effectually overcome the pollution of air, water and soil. But the careful student, aided by the interesting and very full discussions on nearly every paper, will readily eliminate the fancies from the facts.

On the whole we know of no other society which contributes as much material towards the advancement of sanitary engineering.

The last three volumes contain papers among others on the following topics: Descriptions of the sewage works at Hanley, Barnsley, Shildon, West

Derby, Dewsbury and Leistrum Beck. Separate papers on The Separate System of Town Drainage. Papers on Sewerage details, viz.: Sluices, Penstocks, Junction Blocks and Connections with House Drains, Sanitary Supervision of Dwellings, Sewer Ventilation, Sewer Gas Nuisance and its Remedy, Shaw's Ejector System, Hanson's Sewage Process, Rivers Conservancy and Floods Prevention Bill, Sanitary Legislation, Roadways, Wood Pavements, Steam Road Rolling, Asphalt and its application to Street Paving, Street Lighting of the Future, etc., etc.

THE NEW PATENT LAW OF BRAZIL.

The new law of industrial privileges, or patents, was finally passed by the Chamber of Deputies, in third reading, on the 27th ult., there remaining only the formal signing of the decree by the Emperor to give full and legal effect to the measure. The law was originally introduced into the Chamber by the late Minister of Agriculture Buarque de Macedo, where it was passed on the 23d of December, 1880. The narrow, stringent provisions of the measure, however, found little favor in the Senate, where some months since it was substituted by a new and better measure. This substitute was finally passed by the Senate on the 20th of July last, and was then returned to the Chamber for concurrence. The full text of the law is as follows:

The General Assembly decrees:

ARTICLE I.

In the concession of a patent to the author of any invention or discovery, the law guarantees the right of property and exclusive use.

SECTION 1. For the effects of this law the following shall constitute an invention or discovery:

1st. The invention of new industrial products;

2d. The invention of new processes or the new application of known processes for obtaining an industrial product or result;

3d. The improvement of an invention already privileged, if it shall facilitate the manufacture of the product or the use of the privileged invention, or if it shall increase its utility.

Those industrial products, processes, applications and improvements shall be considered new which up to the application for a patent have never, within or without the empire, been employed or used, and of which can neither be found descriptions nor publications of the method by which they can be employed or used.

SEC. 2. The following inventions cannot be made the object of a patent:

1st. Those contrary to law or morality;

2d. Those dangerous to public security;

3d. Those noxious to public health;

4th. Those which do not offer a practical industrial result.

SEC. 3. The patent will be conceded by the executive power, after the fulfilment of the formalities prescribed in this law and in its regulations.

SEC. 4. The exclusive privilege of a principal invention will only be valid up to fifteen years, and that of an improvement to the invention, conceded to the author, will terminate at the same time with it.

If public necessity or utility require the free use (*vulgarisacao*) of an invention, or its exclusive use by the state, during its privilege, the patent can be disappropriated, in conformity with the legal formalities.

SEC. 5. The patent is transmissible by any of the modes of cession or transference recognised by law.

ARTICLE II.

Inventors receiving privileges in other countries can obtain a confirmation of their rights in this empire, provided that they fulfil the formalities and conditions of this law, and observe the further dispositions in force applicable to the case.

The confirmation will give the same right as a patent conceded in the empire.

SEC. 1. The priority of the property right of that inventor who, having solicited a patent from a foreign country, shall make a similar petition to the imperial government within seven months, will not be invalidated by facts which may occur during this period, to wit, another similar petition, the publication of the invention, and its use or employment.

SEC. 2. To the inventor who, before obtaining a patent, desires to experiment in public with his inventions, or wishes to exhibit them in an exposition, official or officially recognised, will be granted a title provisionally guaranteeing to him his right of property for a specified time, and with the formalities required.

SEC. 3. During the first year of the privilege only the inventor himself, or his legal successors, can obtain a privilege for improvements on his own invention. It will be permitted to third parties, however, to present their petitions within the said period in order to establish their rights.

The inventor of an improvement cannot engage in the industry benefited while the privilege for the principal invention lasts, without an authorization from its author; nor can the latter employ the improvement without an accord with him.

SEC. 4. If two or more persons solicit a privilege at the same time for an identical invention, the Government, except in the hypothesis of Section 1 of this article, will require that they shall previously determine the priority, either by means of an accord or in a competent court.

ARTICLE III.

The inventor who seeks a patent will deposit in duplicate in the department which the Government shall designate, within a closed and sealed envelope, a report in the national idiom, describing the invention with accuracy and clearness, its purpose and the method of using it, with the plans, designs, models and samples which may contribute to an exact understanding of the invention and the elucidation of the report, so that any person cognisant of the subject can obtain or apply the result, means or product of which it treats.

The report shall clearly specify the characteristic features of the invention (*privilegio*).

The extension of the right of patent will be determined by the said features, mention of this being made in the patent.

SEC. 1. With the document for deposit will be presented the petition, which should be limited to one single invention, specifying its nature and its purposes or applications, in accordance with the report and with the documents deposited.

SEC. 2. If it shall appear that the subject of the invention involves an infraction of Sec. 2, Art. 1, or has for its object alimentary, chemical or pharmaceutical products, the Government will order a previous and secret examination of one of the copies deposited, in conformity with the regulations to be issued; and in accordance with the result it will or will not concede a patent.

From a negative decision there will be recourse to the Council of State.

SEC. 3. With the sole exception of the cases mentioned in the preceding paragraph, the patent will be issued without previous examination.

In it the object of the privilege will always be designated in a concise manner, with a reserve of the rights of a third party, and of the responsibility of the Government, in respect to the originality or utility of the invention.

In the patent of an inventor privileged outside of the empire, it will be declared that it is valid so long as the foreign patent is in force, never exceeding the specified period of Sec. 4, Art. 1.

SEC. 4. Beside the expenses and fees incurred the patentees shall pay a tax of 20$ for the first year, 30$ for the second, 40$ for the third, increasing 10$ for each year that shall ensue over the preceding annuity for the whole period of the privilege. In no case will the annuities be refunded.

SEC. 5. To the privileged inventor who improves his own invention will be given a certificate of improvement which will be appended to the respective patent.

For this certificate the inventor will pay once for all an amount corresponding to the annuity which has become due.

SEC. 6. The transfer or cession of patents or certificates will not enter into effect until it has been registered in the Bureau of Agriculture, Commerce, and Public Works.

ARTICLE IV.

The patent having been issued, and within a period of thirty days, the opening of the deposited envelopes will take place with the formalities which the regulations shall specify.

The report shall be immediately published in the *Diario Official*, and one of the copies of the designs, plans, models or samples will be opened for the inspection of the public and for the study of interested parties, it being permitted to take copies.

SEC. 1. In case the previous examination of which Sec. 2, Art. III., treats, has not taken place, the Government, having published the report, will order a verification, by means of experiments, of the requisites and conditions required by law for the validity of the privilege, according to the method established for such examination.

ARTICLE V.

A patent will become of no effect if it is annulled or shall lapse.

SEC. 1. The patent will become null:

1st. If in its concession any one of the requirements of Sections 1 and 2 of Art. 1 has been infringed.

2d. If the patentee did not have priority;

3d. If the patentee shall have falsified the truth or concealed essential matter in the report descriptive of the invention, whether in its object or in the manner of using it;

4th. If the name of the invention shall be, with fraudulent purpose, diverse from its real object;

5th. If the improvement shall not have the indispensable relation with the principal industry, and can be constituted a separate industry, or there shall have been priority (*preterição*) in the preference established by Art. II., Sec. 3.

SEC. 2. The patent will lapse in the following cases:

1st. The patentee not making effective use of the invention within three years, counting from the date of patent:

2d. The patentee suspending the effective use of the invention for more than one year, except by cause of *força majeur* judged sufficient by the Government, after consulting the respective section of the council of state;

By use is understood in these two cases, the effective exercise of the privileged industry, and the supply of the products in proportion to their employment or consumption.

It being proved that the supply of the products is evidently insufficient for the needs of employment or consumption, the privilege can be restricted to a zone determined by an act of the Government, with the approval of the legislative power.

3d. The patentee not paying the annuity within the terms of the law;

4th. The patentee, residing outside of the empire, not constituting an accredited agent to represent him before the Government, or in court;

5th. Through the express renunciation of the patent;

6th. The patent or foreign title upon an invention also privileged in the empire, being discontinued;

7th. The term of the privilege having expired.

SEC. 3. The nullity of a patent or of a certificate of improvement will be declared by a decision of the commercial court (*juizo commercial*) of the capital of the empire, by means of the summary process of decree No. 737, of Nov. 25, 1850.

The following are competent to promote an action for nullity:

The solicitor of the treasury (*procurador dos feitos da fazenda*) and his assistants, to whom will be forwarded the documents and proofs, corroborative of the infraction;

And any interested party with the assistance of that official and his assistants.

An action of nullity in the cases of Art. I. Sec. 2, Nos. 1, 2 and 3, having been begun, the execution of the patent and the use or employment of the invention will remain suspended until the final decision.

If the patent shall not be anulled, the patentee will be reinvested in its enjoyment with the integrity of the term of privilege.

SEC. 4. The lapse of patents will be declared by the Minister and Secretary of State for the affairs of agriculture, commerce and public works, with recourse to the Council of State.

ARTICLE VI.

The following will be considered infractors of the privilege:

1st. Those who, without license from the patentee, manufacture the products, or employ the processes, or make the applications which are the object of the patent;

2d. Those who import, sell, or expose for sale, conceal or receive for the purpose of sale, counterfeited products of the privileged industry, knowing what they are.

SEC. 1. The infractors of a privilege will be punished, in favor of the public coffers, with a fine from 500$ to 5,000$; and in favor of the patentee with from 10 to 50 per cent. of the damage caused, or which may be caused.

SEC. 2. The following will be considered as aggravating circumstances:

1st. The infractor to be or to have been an employé or workman in the establishment of the patentee.

2d. The infractor to associate with an employé or workman of the patentee for acquiring knowledge of the practical method of obtaining or employing the invention.

SEC. 3. The cognizance of infractions of a privilege belongs to the *juizes de direito* (district judges) of the *comarcas* (districts) where they reside, who will issue, on the petition of the patentee or his legal representative, the warrants of search, apprehension and deposit, and will prescribe the preparatory or preliminary proceedings of the process.

The sentence will be governed by law No. 562, of July 2, 1850, and by decree No. 707, of Oct. 9, of the same year, so far as they apply to the case.

The products of which Nos. 1 and 2 of this article treat, and the respective instruments and apparatus, will be adjudged to the patentee by the same sentence which condemns the authors of the infractions.

SEC. 4. The process will not hinder an action by the patentee to secure indemnification for damage caused or which may be caused.

SEC. 5. Commercial jurisdiction is sufficient for all the causes relative to industrial privileges, in conformity with this law.

SEC. 6. The following will be punished, with a fine of from 100$ to 500$, in favor of the public coffers:

1st. Those who announce themselves as possessors of a patent, using the emblems, marks, inscriptions or labels upon products or objects pre-

pared for commerce or exposed for sale, as if they had been privileged.

2d. Those inventors who continue to exercise an industry, as privileged, the patent being suspended, annulled or lapsed.

3d. Those privileged inventors who, in prospectuses, advertisements, inscriptions, or by any mode of public notice shall mention patents without designating the special objects for which they were obtained.

4th. Those professional men or experts who, in the hypothesis of Sec. 2, of Art. III., cause the general diffusion of the secret of the invention, without prejudice in such case, to the criminal or civil actions which the laws permit.

SEC. 7. The infractions of which the preceding paragraph treats will be prosecuted and judged as political crimes, in conformity with the legislatien in vigor.

ARTICLE VII.

When a patent shall be conceded to two or more co-inventors, or when it becomes common by a title of gift or succession, each one of the co-proprietors can use it freely.

ARTICLE VIII.

If a patent shall be given or left in usufruct, the usufructuary will be obliged, when his rights cease through the the extinction of the usufruct or termination of the term of privilege, to give to the owner of the property the value at which it shall be estimated, calculated with relation to the time which the usufruct has lasted.

ARTIOLE IX.

The patents of invention already conceded will continue to be governed by the law of Oct. 26, 1830, there being applied to them the dispositions of Art. V., Sec. 2, Nos. 1 and 2, and of Art. VI., of this present law, with the exception of pending processes or actions.

ARTICLE X.

All dispositions to the contrary are hereby revoked.—*Rio News, Oct.* 5.

SOME BIG THINGS.

The largest suspension bridge will be the one now building between Brooklyn and this city. The length of the main span is 1,595 ft. 6 in. The entire length of the bridge is 5,989 ft.

The Pennsylvania Railroad's new locomotive Jumbo has seven-feet driving wheels, and has drawn a train from Philadelphia to Jersey City, a distance of ninety miles, in eighty minutes.

Fortress Monroe is the largest single fortification in the world. It has already cost the government over $3,000,000. The water battery is considered one of the finest military works in the world.

The loftiest active volcano is Popocatepetl (smoking mountain), thirty-five miles southwest of Pueblo, Mexico. It is 17,784 ft. above the sea level, has a crater three miles in circumference and 1,000 ft. deep.

The longest span of wire isused for a telegraph in India over the river Kistnah, between Bezorah and Sectanagrum. It is more than 6,000 ft. long, and is stretched between two hills, each 1,200 ft. high.

The largest university is Oxford, in Oxford, England. It consists of twenty-five colleges and five halls. Oxford was the seat of learning in the time of Edward the Confessor. It claims to have been founded by Alfred.

The largest ship is the Great Eastern. She is 680 ft. long, 83 ft. broad and 60 ft. deep, being 22,927 burden, 18,915 gross and 13,344 net register. She was built at Millwall, on the Thames, and was launched Jan. 31, 1857.

The most extensive park is Deer Park, in the environs of Copenhagen, Denmark. The enclosure contains about 4,200 acres, and is divided by a small river. The largest pleasure ground in this country is Fairmount Park, Philadelphia, which contains 2,740 acres.

The largest body of fresh water on the globe is Lake Superior. It is 400 miles long, 160 miles wide at is greatest breadth, and has an area of 32,000 square miles. Its mean depth is said to be 200 ft., and its greatest depth about 900 fathoms. Its surface is 635 ft. above the sea.

The largest tunnel in the world is that of St. Gothard, on the line of railroad between Lucerne and Milan. The summit of the tunnel is 990 feet below the surface at Audermatt, and 6,600 feet beneath the peak of Kastelhorn, of the St. Gothard group. The tunnel is 26½ feet wide, and 19 feet 10 inches from the floor to the crown of the arched roof. It is 9½ miles long, 1⅛ miles longer than the Mt. Cenis tunnel.

The most extensive cavern is the Mammoth Cave in Edmondson County, Ky. It is near Green River, six miles from Cave City, and about twenty-eight miles from Bowling Green. The cave consists of a succession of irregular chambers, some of which are large, situated on different levels. Some of these are traversed by navigable branches of the subterranean Echo River. Blind fish are found in its waters.

The largest trees are the mammoth trees in California. One of a grove in Tulare County, according to measurement made by members of the State Geological Survey, was shown to be 276 feet high, 106 feet in circumference at base, and 78 feet at a point 12 feet above the ground. Some of the trees are 376 feet high and 34 feet in diameter. Some of the largest that have been felled indicate an age of from 2,000 to 2,500 years.

The largest inland sea is the Caspian, lying between Europe and Asia. Its greatest length is 760 miles, its greatest breadth 270 milee, and its area 180,000 square miles. Great Salt Lake, in Utah, which may be properly termed an inland sea, is about 90 miles long and has a varying breadth of from 20 to 25 miles. Its surface is 4,200 feet above the sea, whereas the surface of the Caspian is 84 feet below the ocean level.

The largest empire in the world is that of Great Britain, comprising 8,577,658 square miles, more than a sixth part of the land of the globe, and embracing under its rule nearly a sixth part of the population of the world. In territorial extent the United States ranks third, containing 3,580,242 square miles, including Alaska; in population it ranks fourth with its 50,000,000 people. Russia ranks second: 8,352,940 square miles.

The highest monolith is the obelisk at Karnak, Egypt. Karnak is on the east bank of the Nile, near Luxor, and occupies a part of the site of an ancient Thebes. The obelisk is ascribed to Hatasu, sister of Pharaoh Thothmes III., who reigned about 1600 B. C. Its whole length is 122 feet, its weight 400 tons. Its height, without pedestal, is 108 feet 10 inches. The height of the obelisk in Central Park, without pedestal, is 68 feet 11 inches, its weight about 168 tons.

The Chinese wall is the largest wall in the world. It was built by the first emperor of the Tain dynasty, about 220 B. C., as a protection against Tartars. It traverses the northern boundary of China, and is carried over the highest hills through the deepest valleys, across rivers and every other natural obstacle. Its length is 1,250 miles. Including a parapet of 5 feet, the total height of the wall is 20 feet; thickness at the base 25 feet and at the top 15 feet. Towers or bastions occur at intervals of about 100 yards.

The largest library is the Bibliotheque National in Paris, founded by Louis XIV. It contains 1,400,000 volumes, 300,000 pamphlets, 175,000 manuscripts, 300,000 maps and charts, and 150,000 coins and medals. The collection of engravings exceeds 1,800,000, contained in some 10,000 volumes. The building which contains these treasures is situated on the Rue Richelieu. Its length is 540 ft., its breadth 130 ft. The largest library in New York, in respect of separate works, is the Astor. About 190,000 volumes are on its shelves.

Among the most remarkable natural echoes is that of Eagle's Nest, on the banks of Killarney, in Ireland, which repeats a bugle call until it seems to be sounded from 100 instruments; and that on the banks of the Naha, between Bingen and Coblentz, which repeats a sound 17 times. The most remarkable artificial echo known is that in the Castle of Simonetta, about two miles from Milan. It is occasioned by the existence of two parallel walls of considerable length. It repeats the report of a pistol sixty times.

The largest bell in the world is the great bell of Moscow, at the foot of the Kremlin. Its circumference at the bottom is nearly 68 ft., and its height more than 21 ft. In its stoutest part it is 23 in. thick, and its weight has been computed to be 443,772 lbs. It has never been hung, and was probably cast on the spot where it now stands. A piece of the bell is broken off. The fracture is supposed to have been occasioned by water having been thrown upon it when heated by the building erected over it being on fire.

The big bridge across the Kinzua chasm on the Erie extension, 15 miles south of Bradford, Pa., was completed about two weeks ago, and trains will soon be running over it. The bridge is a symmetrical iron structure, and is the highest in the world, the centre span being 301 ft. in height, and the length of the structure is 2,060 ft. It was built by the Keystone Bridge Co. of Phœnixville, Pa. The completion of this bridge gives the New York, Lake Erie & Western Railroad direct communication to the coal field of western Pennsylvania.

The largest cathedral in the world is St. Peter's in Rome. From the laying of its foundation in 1450 until its dedication, 170 years were consumed in its erection; and if we include the work done under Pius VI., three and a half centuries passed before it was complete, during which time 43 popes reigned. The dimensions of the church are: length of the interior, 613½ ft.; of transom from wall to wall, 446½ ft.; height of nave, 152½ ft.; of side aisles, 47 ft.; width of nave, 77–89 ft.; of side aisles, 33½ ft.; circumference of pillars which support the dome, 253 ft. The height of the dome from the pavement to the base of the lantern is 405 ft.—to the top of the cross, 448 ft. The dome is encircled and strengthened by six bands of iron. A stairway leads to the roof, broad and easy enough to allow a horse and team to ascend. The annual cost of keeping the church in repair is 30,000 scudi.—*N. Y. Sun.*

HOUSEHOLD ECONOMY IN NEW YORK.

There is no prospect, in fact, of desirable flats—that is, apartments of any size, convenient, light and airy—being other than expensive in this city. It is twelve years since the first apartment-houses were built; hundreds of them of divers grade have been put up all over town; but those capable of accommodating a small family, with an elevator and pleasant well-ventilated rooms, cannot be had for less than from $1,500 to $2,000. There are flats in poor quarters that rent for from $600 to $800, but they usually have dark chambers, they are ill-arranged and are seldom really wholesome. As a generalization, it may be said that reasonable apartments are not good, and that good apartments are not reasonable. The fond anticipations cherished eight or ten years ago that a nice, healthful apartment might be procured for from $500 to $600 annually have long been dispelled. They who have no more than that to spend for a home, so called, are obliged to put up with sundry discomforts, and to jeopard their health more or less by sleeping in dark, close chambers.

It would seem as if economy of any kind were impracticable in this the costliest of capitals. The mere decencies of life are well nigh beyond the reach of men dependent on salaries or ordinary incomes. The average earnings here of men even of education and taste are not, it is alleged, in excess of $1,500 to $1,600, and as the majority of them have families (the unwritten law of Manhattan demands that no couple, unless financially independent, shall have more than two children), they are forced into a ceaseless contest for self-sustainment. They toil through life, endure vexation, disappointment, tribulation, pain, and quit the world leaving no provision for their families, but generally in debt. Comparatively few men who can command credit die, it is said, with all their liabilities discharged. The proportion of New Yorkers of whom this is true must be larger than of other citizens, for credit here is easily got, and the cost of living is far greater than elsewhere.

What can be expected of a husband and a father who can earn no more than $1,500 or $1,600? How is it possible for him to stem the current always running so strong against him, especially against the refined and sensitive poor of Anglo-Saxon strain? It is clear that he can not live in the city proper; he must pitch his tent, as it may justly be styled, in the rear of Brooklyn, along the lines of the New Jersey railroads, among the sand knolls of Long Island, or amid the pastures of Westchester. He must come and go daily to and from his business in every sort of weather, keeping mind and nerves on the stretch lest he miss the boat or train. His wistful life is regulated by schedule time; he is ever hurried, planning to save a few minutes, and yet wasting, from the perpetual stress of circumstance, his entire years. He has no leisure, no repose; he is absorbed in town, feverish in the country; he sees little of his family, nothing of his friends; he is engrossed with his petty affairs, which he may despise, but which he can not afford for an hour to neglect. His life is a dull, wearisome round, his most serious thought how he shall get on, and while still thinking of it the cord snaps and the end comes. He has done his work. True; but was it worth doing? After years of grinding labor, what has he achieved; where is his recompense? He has been striving faithfully for his family, and at the close he leaves them the discouragement of his example, and probably a legacy of debt. Such is the inspiring destiny of the average New Yorker. Verily is honesty its own and only reward!—*Junius Henri Browne, in Harper's Magazine for November.*

THE BENEFIT OF SEWERAGE.

Crowded centers afford the most striking illustration of what can be done both in the way of developing disease-generating germs, and also in destroying them or averting their effects, as shown by the death statistics of cities under varying conditions of sanitary efficiency. Thus in London the death rate during the five years following 1668 was 27.0; during the same number of years ending in 1881, it was 23, and last year it was only 21.7. The city of Munich offers perhaps the most striking illustration of the effects of sanitary efficiency. Between 1854 and 1859, when there was a total absence of all attempts at sanitation, the death rate from enteric fever was 24.2 per million; from 1860 to 1865, when the porous sides of cesspools were cemented to stop the filtration of sewage into the ground, it was reduced to 16.8; from 1866 to 1873, when the drainage system was partly complete, it was 13.3, and by 1880, when the works were complete, it had sunk to 8.7. In the same way the statistics of many other cities might be adduced, to show the results which follow the prompt removal of sewage, instead of allowing it to remain and develop into active energy the latent forms of elementary life with which it teems.

NOTES.

SHIP CANALS.

The old-fashioned canals, capable only of carrying barges, which won such renown for the Duke of Bridgewater and Brindley, the engineer, a century ago, have now become rather obsolete. If they did not exist no one would construct them, but, as they are made, they form a useful adjunct to the railway for the carriage of heavy or bulky materials of small value. But for the ship canal a new era is opening. Africa has for ten years been an island, and if the Siamese link which binds together those two dissimilar twins, North and South America, is not shortly severed, the delay will be due rather to climatic obstacles or political complications than to engineering incapacity. The exigencies of railway making—the embankments, and cuttings, and tunnels—have taught the modern engineer how to "shift dirt" on a scale which would have been deemed miraculous by the shrewd heads which set "navigators" to work to dig out our old canals, and therefore no task of this sort transcends human ambition. The constantly increasing use of steam also, to the supersession of sailing ships, renders canals of more practical importance than formerly. A sailing ship, unaided by a fair wind, would naturally make very slow progress along a narrow cut of water, whereas a steamer—on account of the smoothness of the surface—shows to better advantage there than on the sea. Hence we have ambitious projects of ship canals in various quarters. France desire to islandise herself by cutting a broad, deep dyke from Bordeaux to the Mediterranean; Germany proposes a water-way from the Baltic to the North Sea, across Holstein, thus rendering herself independent of a possible Danish blockade of the Sound; Manchester plans to become a seaport, to bring the briny ocean close to Market street, and leave her old rival Liverpool stuck in the mud. This latter project is to be achieved either by a canal from the Mersey, or, better still, by utilizing the neglected estuary of the Dee. And if Manchester succeeds in her scheme, why not extend the canal on to Birmingham, and thence to London? Before many years we may see one of the monsters of the deep which are owned by the Cunard Company or the P. and O. steaming through the green meadows of Warwickshire.—*London Illustrated News.*

WHAT IS SEWER GAS?

What is sewer gas? This term has been employed a long time by chemists, sanitarians, plumbers and others to indicate the ordinary emanations from sewers; but recently certain gentlemen have taken exceptions to the term, denying that there is any such thing as sewer gas "having a peculiar and definite composition." This is undoubtedly true, and it is probable that no intelligent man or educated physician ever thought otherwise. What has been called "sewer gas" is composed of air, vapor and gases in constantly varying proportions, together with living germs—vegetable and animal—and minute particles of putrescent matter. In short, it is composed of whatever is sufficiently volatile or buoyant to float in the atmosphere, and in consequence of which buoyancy it is permitted to escape through the various sewer-outlets. The term is, in this sense, well understood, and it is, moreover, just as correct as would be the terms sewer vapor or sewer air, which some have chosen to substitute for it. It is proper here to add that the offensiveness of odors is no test of their insalubrity, but that the most fatal germs are often conveyed in an atmosphere which is odorless. The absence of unpleasant odors, therefore, furnishes no proof that the air does not contain sewer emanations—*Popular Science Monthly.*

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

HAMILTON, O., will endeavor to procure the necesary legislation to give the city the power to issue bonds for water-works without having to wait until next spring for a "general election."

BLOOMINGTON, Ill., will probably be lighted by gas from a well recently discovered. A company with a capital of $100,000 has been formed to pipe the town.

STREETS, DRAINAGE, ETC.

AN English company offer $1,000,000 for the privilege of draining Lake Leman in Switzerland, provided they can have the land thus laid bare. They propose to drain it into the River Rhone by means of a canal 20 miles long.

DRAINAGE OF NEW JERSEY RESORTS.—LONG BRANCH, Nov. 1.—The Grand Jury has brought in presentments against the towns of Long Branch, Ocean Grove, Ocean Beach and Asbury Park, on account of the alleged imperfect drainage of those summer resorts, which is received with profound astonishment by the citizens of the localities named. To your reporter, Mayor James A. Bradley, of Asbury Park, stated that the action of the Grand Jury is regarded as a severe blow to the interests of the summer resorts all along the shore. Mayor Bradley said positively that no sewers are run into the lakes and rivers of Asbury Park or Ocean Grove. No sewers are run into Shark River, and besides the ocean's tide flows into that stream. The Common Councils of the four towns mentioned claim that they can prove that their respective corporations are properly drained, and think as a matter of justice they should be granted at the earliest possible moment an opportunity to refute the charges which the Grand Inquest has seen fit to bring into court. Two members of the Grand Jury are from Long Branch, and two others from Asbury Park. In addition to the above-named presentments, G. B. Sant, of the Octodon House; C. H. Dederer, of the Peninsula Hotel; M. Roseveit, of the Casino; Road-Master John N. Megill, the Rev. Miflin Paul, James H. Corey, of the Hotel Bellevue, and William H. Cooper, all at Seabright, were indicted "for allowing their drains to be discharged into the Shrewsbury River, creating the noxious, filthy, offensive and unhealthy substances and unwholesome matter complained of."

RIVERS AND HARBORS.

CANNOT BUILD A LIGHT-HOUSE.—VICTORIA, B. C., Nov. 7.—Nothing but disaster has attended the effort to construct an iron light-house at the mouth of Frazer River. After the experience of two seasons and the fruitless exertion to obtain a foundation for the structure, the attempt will be abandoned and the lightship re-established. The last report from the spot is that the stone dumped there and the cribbing are all washed away or covered by constantly shifting sand.

THE Congressional Committee has started on its tour to find out what improvements are needed on the Mississippi River.

RAILROADS.

COLOR BLINDNESS.—Copying the Pennsylvania Railroad Company, the Pittsburgh, Cincinnati & St. Louis management will, in a few days, commence the examination of train employés upon color-blindness and defective vision, and employés who fail to pass examination will be relieved.

A NEW IDDIANA ROAD.—A project is on foot to build a railroad from the coal fields in Parke County north to Clark's Hill, and to extend it further north in the future.

THE Springfield & Southern Railway Company has filed articles of incorporation at Springfield, Ill. The road runs as follows: From a point in the city of Springfield, Ill., thence in a southerly direction to a point on the east bank of the Mississippi River in the county of Jackson, with a branch line commencing at a point upon said main line in the county of Montgomery or in the county of Madison, and from thence to a point in the city of East St. Louis in the county of St. Clair, Ill., the principal business office to be at Mattoon, reserving the privilege of changing said office to the city of Springfield. Capital stock $500,000, with privilege to increase to $3,000,000.

CAPITALISTS have been given the privilege of building a street railway in Petersburg, Va.

THE CANADIAN PACIFIC.—WINNIPEG, Man., Nov. 17.—The Canadian Pacific Railway is now graded to Maple Creek, and work is being rapidly pushed toward South Saskatchewan. There will be heavy grading at the latter place on both sides of the river. Tracklayers are now twenty miles west of Swift River Current Creek. The bridge here is about 175 ft. in length. Work on the permanent bridge has not yet been commenced, and only a temporary bridge will be constructed over the South Saskatchewan River this season. The Southwestern Branch tracklaying has reached a point eighty-eight miles from Winnipeg.

ARTICLES of incorporation are being drawn up for the Albion, Carmi & Shawneetown Railway Company. The road is to run from Olney, Ill., south to Shawneetown, a distance of eighty-five miles. The capital stock has been placed at $1,000,000, and the principal office located at Carmi.

THE first sod of the Interoceanic Railroad was turned on the 1st inst. at Salina Cruz, Mexico, in the presence of the authorities of Tehuantepec and a numerous crowd. About 500 men then began to work.

COLORADO ROAD.—The Boulder, Left Hand & Middle Park Railroad have begun grading in several places on their line.

A PAGE OF HISTORY.—From papers now in the possession of certain of the Nickle-Plate officers, it appears that there is connected with the new road a history extending back over a quarter of a century. As early as 1857, the road-bed of a trunk line, with a route similar to that of the present Nickle-Plate, was built. This road was known as the American Central, and was projected by a son of Dewitt Clinton in 1853. The original plan contemplated a road to run from Hudson, O., to the state line of Pennsylvania. From the eastern terminus the line was to extend to the sea-board, and was known as the Clinton division, while a western division was called the Tiffin & Fort Wayne Railway. Work began almost simultaneously upon each of the three divisions of this American Central, and by the summer of 1857 more than 200 miles were graded, ready for the ties. The scheme was incorporated in Pennsylvania, Ohio, Indiana, and Illinois: but in the panic of 1857 the project went to pieces. Nothing more was done until about 1865, when Adam Smith projected a trunk line from the Atlantic to Omaha. Mr. Smith went to England to purchase rails, and was never heard from more. In 1870, Wm. Wood, of Jersey City, engaged an engineer, and re-surveyed the whole route. The project failed to materialize, but additional right of way had been secured and large subscriptions voted. In 1873, all these projects, contemplating the building of a trunk line over about the same route, failed, and only the graded road-bed, extending for miles, remained as a fitting monument of the people's losses. Among the heavy investors in the trans-continental schemes was W. H. Gibson, of Tiffin, O. He attended every sale of the right of way, and gradually acquired control of the strip of property extending 200 miles through the heart of Ohio, and wide enough for a double-track railroad. This right of way, representing several million dollars, was offered to Vanderbilt, but he would not take the property. It was offered to Gould, but he had no use for it. Finally, Gibson saw George I. Seney, and a trade was struck for the purchase of this valuable right of way and road-bed for $100,000. W. H. Gibson obtained his $100,000, and he was the only person of the hundreds who sunk in the aggregate $5,000,000 that ever received any return for his investment.

TWO NEW PENNSYLVANIA ROADS.—A charter was granted on the 9th to the Erie & Wyoming Valley Railroad Company, the line of which is 68 miles long, running from Port Griffith, Luzerne County, to Lackawaxen, Pike County, through Luzerne, Lackawanna, Wayne and Pike counties. The capital stock is $3,000,000, and the officers are: President, Edward W. Clymer, Reading; Directors, Samuel Hines, William A. Way, Charles E. Bradbury, E. W. Ives, Scranton; E. P. Dasling, J. V. Dasling, Wilkesbarre. A charter was also granted to the Pittsburgh & Whitehall Railroad Company, the line of which is to be seven miles long, all in Allegheny County; capital stock, $300,000. President, Oliver D. Phillips.

The Wheeling *Intelligencer* of the 29th ult. says: "There seems to be no longer any doubt that the Baltimore & Ohio Railroad Company has purchased the narrow-gauge line between Pittsburgh and Washington, Pa., known as the Pittsburgh Southern, and that the purpose is to rebuild a portion of it and make the line a standard gauge road, and, as such, their route from Pittsburgh to the West, by way of this city. The same company is also pushing its rights of way along the line of the Hempfield extension between Washington, Pa., and the Monongahela River, and will probably let the line to contractors in a few weeks. It is understood here that the Vanderbilt line, known as the South Pennsylvania, which has been surveyed between Harrisburg, Pa., and this city, is nearly ready to be let to contractors. The River Railroad between this city and Parkersburg, projected under the auspices of Senator Camden, of this State, and a syndicate of capitalists, is surveyed and located and about ready to let. It is understood that the South Pennsylvania will cross the river here on a bridge, and connect with the Wheeling & Lake Erie road, now completed from Toledo to within fifty-eight miles west of this city. When the Hempfield extension is completed between this city and the Connellsville division of the Baltimore & Ohio, it will be their main line east from Chicago, and will materially shorten the distance and save one mountain grade."

THE MEXICAN CENTRAL.—A recent official statement of the Mexican Central Company to the New York Stock Exchange declares that the main line of the Mexican Central road extends from the City of Mexico to Paso del Norte, 1,300 miles, where it connects with the Atchison, Topeka & Santa Fe, the Southern Pacific and the Texas & Pacific roads. The Western interoceanic branches will extend to San Blas on the Pacific Ocean, 430 miles, and the Eastern branch to Tampico on the Gulf of Mexico, 318 miles. Five hundred and twenty-two miles of road have been completed, of which 483 miles are on the main line. The progress of construction justifies expectations of completing the road early in 1884.

BRIDGES.

A NEW bridge company has been formed in East Saginaw, Mich., to bridge the Cass River. Capital stock, $10,000.

A COLORADO BRIDGE FINISHED.—The Greeley, Salt Lake & Pacific (N. P.) Railroad have completed the bridge in Boulder Cañon and have began to lay steel.

BUILDING.

A NEW HOTEL is being built at Manistique, Mich.

THE new Court-house at Mason City, Iowa, is rapidly nearing completion.

THE Washington monument is now 332 feet high.

LABOR.

LABORERS in Montreal are getting from $1.50 to $1.75 per day, and the demand at these figures is greater than the supply.

TUNNELS.

THE tunnel on the New York, West Shore & Buffalo Railway, at Weehawken, was pierced on the 8th inst., and the entire length of 4,000 feet can now be walked through. It is now 20 months since commencement of work. It will be entirely completed next month. A full description of this work appeared in ENGINEERING NEWS of June 17, 1882.

CONTRACTS LET.

A RAILROAD CONTRACT LET.—A despatch from Columbus, O., dated Nov. 2, says: The Redfield syndicate to night signed the contracts with Stearns, Norris & Co., for building the Columbus & Eastern Railway east from this city for sixty miles to the Moxahal coal fields, the road to be ready for cars Aug. 1, 1883.

A FLORIDA CONTRACT LET.—The contract for the work on the Apalachicola Harbor has been awarded to Mr. John McGuire, the lowest bidder, and operations will soon begin.

A FLORIDA WATER-WORKS CONTRACT LET.—The Sanford water-works will be completed in ninety days. The contract for the construction of the same has been awarded to Messrs. Ferrell & Muckle, of Philadelphia.

BUILDING CONTRACT LET.—Thos. W. Boyd, of Pittsburgh, has been given the contract to build the new Lexington (Ky.) Court-house, and his plans accepted. The contract price is $91,000, and the building will be of stone.

A CONTRACT has been let for building a new jail at Camden, N. J.

TRUSS-BRIDGES.*

AN ILLUSTRATED HISTORICAL DESCRIPTION OF ALL EXPIRED PATENTS ON TRUSS-BRIDGES, WHICH UNDER THE LAW ARE NOW PUBLIC PROPERTY AND FREE TO BE USED BY ANY ONE.

By F. B. Brock, Patent Attorney, Washington, D. C.

Hermann Haupt, of Pennsylvania, filed, Dec. 27, 1839, papers of protection in the Patent Office for the term of fourteen years.

Haupt has a grievance. He says that "theory, observation, and experiment all agree in the conclusion that one-half of the inclined pieces are of no use as counter braces, and badly answer the purpose of ties." He instances some bridges on railroads in Pennsylvania, in which the lower ends of the counter braces were all split while the main braces were intact.

His proposed improvement is represented by the diagram marked *A*. Instead of counter braces, vertical ties are used whereby the weight instead of exerting a cross strain, as in the ordinary lattice, is made to act in a direction parallel to the fibres of the tie.

The truss consists simply of the chords *c*, the braces *b*, and the ties *a*, framed precisely as a lattice truss. In this plan the depth of the arch is necessarily small.

The trusses *B* and *C* consist of a series of curved chords, which vary in size according to pressures, and connected with braces and ties in precisely the same manner as has been explained in connection with the truss *A*. In fact, if the truss *A* be supposed bent into a curved form it will become similar to truss *B*, and *C* differs from it only in the chords not being concentric.

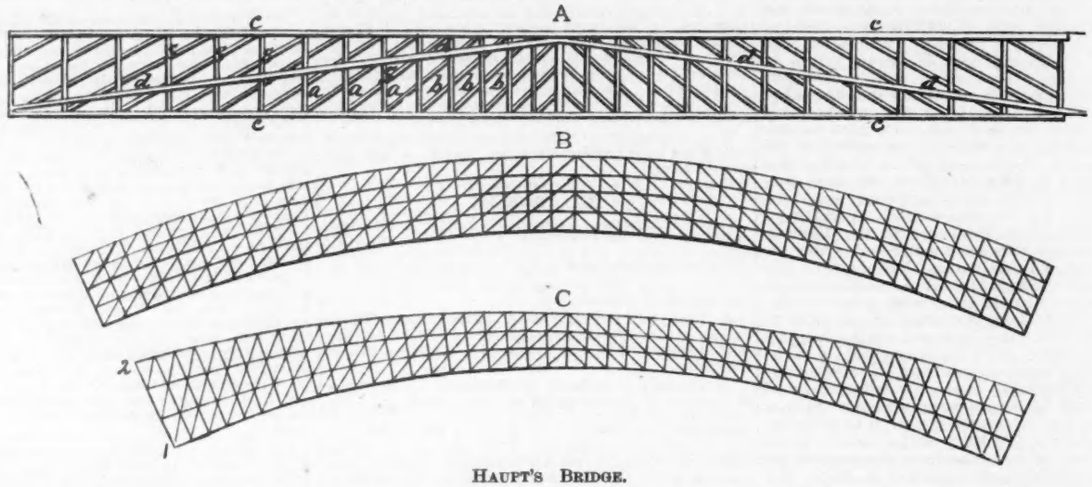
William Howe devised an improvement in truss bridges, the patent for which was granted July 10, 1840. This patent is mainly embodied in a succeeding one which was granted him the following month; and for that reason is not deemed of sufficient importance to be given, beyond a passing mention.

The second patent issued to Howe was dated Aug. 3, 1840, and was re-issued Sept. 3, 1850. The truss frame is, in many respects, like the preceding patent, but it differs therefrom in that the tightening of the bridge is effected by iron rods having screw nuts, and of wedge pieces so placed as to be effective by the action of said screw rods.

Fig. 1 is a side view of the truss, which has rods of iron in the place of the posts for the "straining up," above referred to. Fig. 2 is a top plan view of the truss. 1 1 1 are wedge pieces of hard wood or of iron, which are placed crosswise of the string pieces or chords *a a a' a'*, to form the bearings of the braces and counter braces. Pieces of wood or of iron, 2 2, are also placed at the ends of the truss frames, having their ends bearing against the string pieces for the purpose of counteracting the action of the turning screws. 3 3 are blocks of wood or iron placed between the screw nuts and the chords for the iron bolts or posts to pass through and form an equal bearing on the chords, both above and below the truss frame. 4 4 4 4 are the iron bolts which are to be "strained up" by screw nuts, which have their bearing against the pieces 3, or against washers placed upon them.

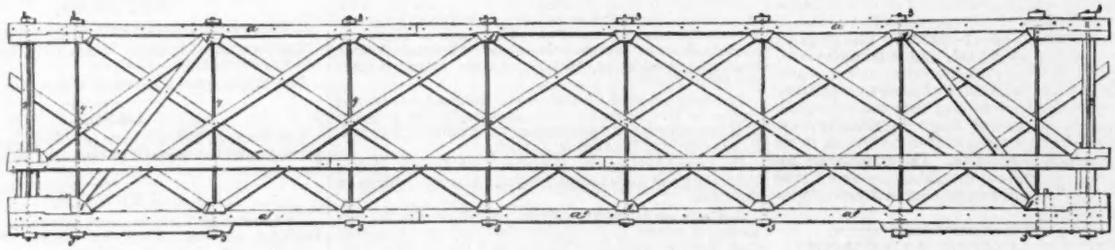
To cause the truss frame to "camber" by the tightening of the screws, it must be so framed in the first instance as that, by the length of the braces inclined toward the center, or by the width given to the upper wedge pieces 1 1, it will camber to a certain extent, which effect will then necessarily be augmented by the tightening of the screws.

(TO BE CONTINUED.)



HAUPT'S BRIDGE.

FIG. 1.



HOWE'S BRIDGE.—FIG. 2.

* Copyright, 1882.